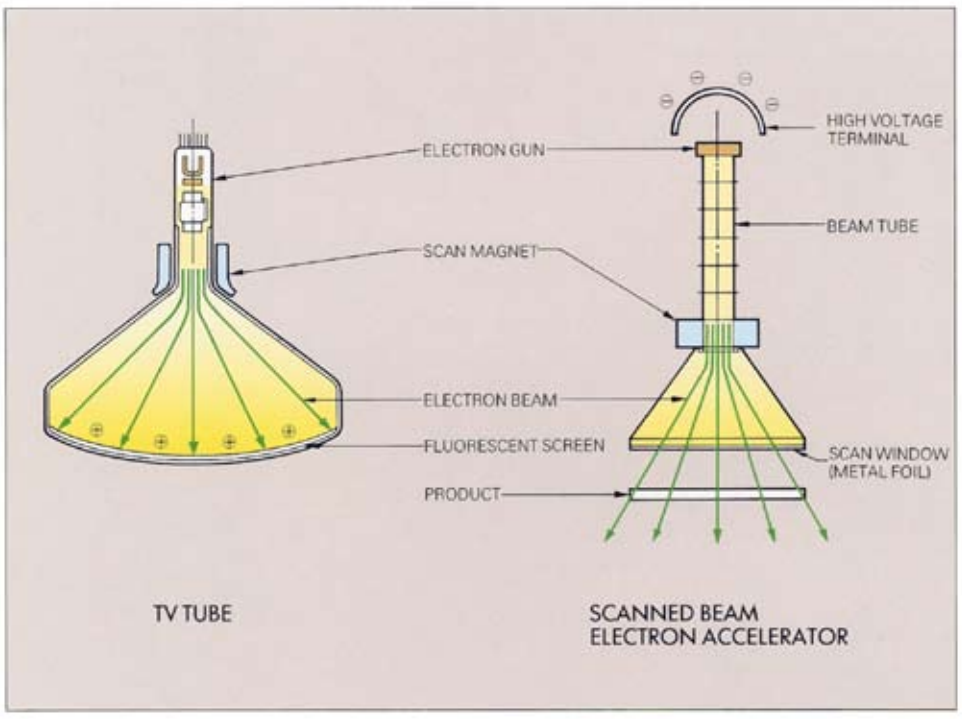
Rapid, Low Temperature Electron-beam, X-ray, and Gamma Ray Curable Resins for Wood Composites

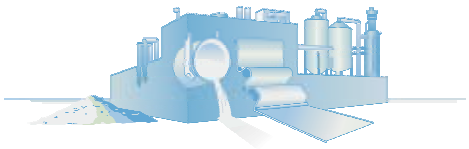
Radiation Treatment Lowers Resin Curing Temperatures, Requires Less Product Drying and Reduces Energy Use

Approximately 50 percent of all wood construction products used today are comprised of some type of glued-wood assembly. Current U.S. production of panel products is around 30 billion ft^2 per year. Glued-wood products are referred to as wood composites, and range from structural laminated beams and flat-pressed panels (such as plywood and fiberboards) to furniture assemblies and non-structural wooden assemblies. The manufacture of most glued-wood assemblies requires process heat to dry the parent wood material, consolidate flat-pressed panel products and to polymerize and cure the resin system.

The use of process heat to polymerize and cure the resin system requires that the moisture content of the wood materials be reduced to low levels. Moisture must be carefully controlled during manufacture to avoid generation of excessive steam vapor pressure internal to the product. Drying the wood furnish materials and controlling the substrate moisture



E-beam curing allows the precise delivery of energy to wood products.



Benefits for Our Industry and Our Nation

- Reduce curing temperatures from 450°F to 250°F
- Reduce the energy used to dry wood products
- Faster curing rates could allow mills to double throughput rates
- Lower curing temperatures will reduce the emissions of volatile organic carbons
- Higher product yields can be achieved by recycling uncured wood materials
- The potential cost savings to industry is $3.2 billion with a current U.S. production of panel products of around 30 billion ft^2/yr
- Potential energy savings of 65 trillion Btu/yr (British thermal units per year) at full market penetration

Applications in Our Nation's Industry

Glued wood assembly products including:

- Structural laminated beams
- Flat-pressed panels
- Furniture assemblies
- Non-structural wood assemblies

Process heat can be reduced in operations including:

- Drying wood
- Product consolidation
- Polymerization and curing the resin system

content is a major consumer of energy in the manufacturing plant. "Hot-pressed" wood panels such as oriented strand board, medium density fiberboard (mdf) and particleboard can be mismanufactured by lack of moisture control.

E-beam resins can be cured at lower temperatures (250-300°F) than conventional systems (450°F.) These lower temperatures reduce heating time, use less energy, emit fewer volatile organic carbons and create less spoilage. In addition, wood products with higher moisture can be processed, process throughput rates are higher, and the resulting wood-resin bonds are more durable. This technology could save 65 trillion Btu/yr if implemented industry-wide.

Project Goals

- Development of e-beam curable resin systems, which lower processing temperature and reduce the energy required to produce a wide range of consumer wood products
- Investigate alternative beam technologies including X-ray or gamma ray
- Evaluate chemical compounds that can initiate the cure of resin systems in response to e-beam or gamma radiation

Pathways

The objectives of this project will be achieved through the determination of (1) test protocols for e-beam curable resins, (2) adhesion properties of new e-beam curable resins used in glued wood composites, (3) curing ability of alternative beam application methods, including gamma rays and X-rays, and (4) protocols for scale up from test samples to large sections and large-scale systems.

Progress and Milestones

- Resin systems with low dose requirements and excellent properties for wood composites have been developed
- E-beam processing of wood-plastic composites with superior properties has been demonstrated
- The application of X-rays for resin curing shows a potential tenfold increase in sample penetration over the electron beam, which could facilitate the curing of larger or thicker materials
- The addition of radiation curable resins to wood plastic composites (WPCs) yields increases in both stiffness and strength, with e-beam treatment significantly improving strength
- Future efforts are needed with respect to pilot testing of the technologies

Project Partners

Virginia Polytechnic Institute and State University

University of Tennessee

Dow Chemical Company

Sartomer Chemical Company

UCB Films

IBA SteriGenics International, Inc.

J. M. Huber Corporation, Engineered Woods

Trus Joist

Morris Johnson, Consultant

For additional information, please contact:

Drew Ronneberg, Ph.D.
Industrial Technologies Program
Phone: (202) 586-0205
Fax: (202) 586-9234
E-mail: Drew.Ronneberg@ee.doe.gov

William L. Griffith, Ph.D.
Oak Ridge National Laboratory
Phone: (865) 574-4970
Fax: (865) 576-2755
E-mail: griffithwl@ornl.gov

A Strong Energy Portfolio for a Strong America

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